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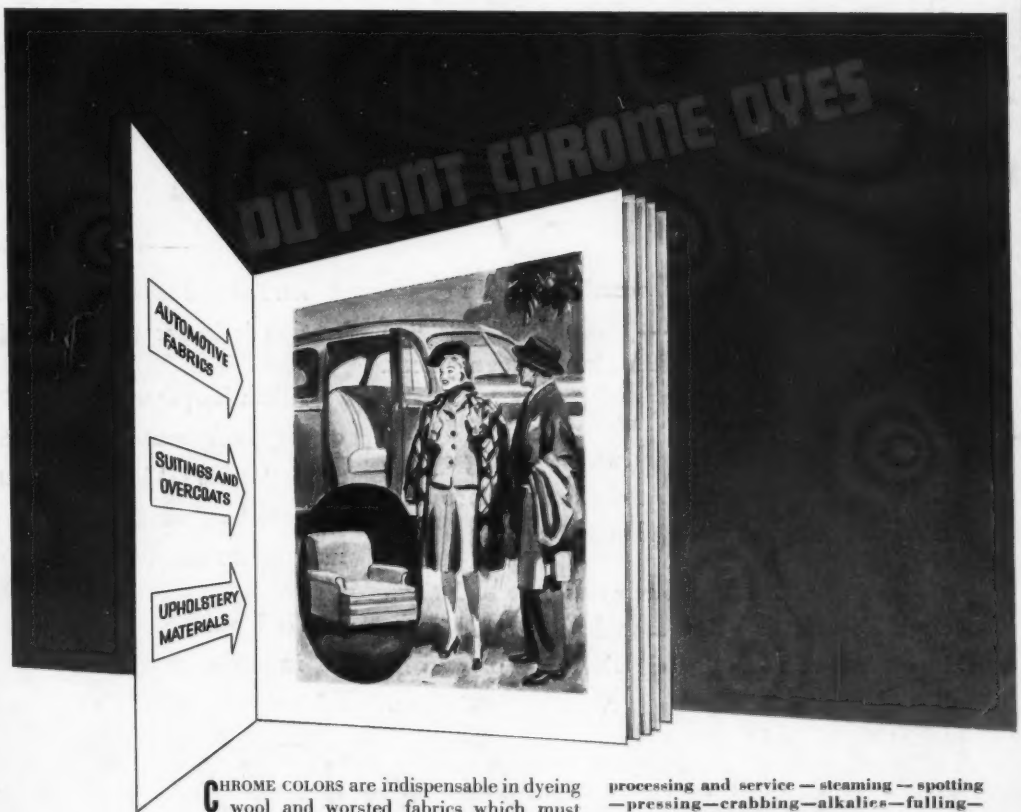

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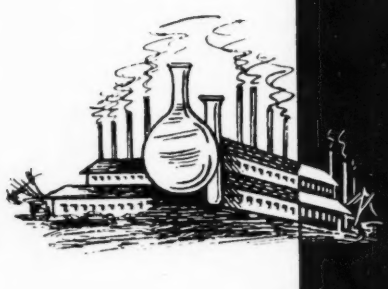

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DYESTUFF REPORTER

VOLUME 30 OCTOBER 13, 1941 NUMBER 21

A Multipurpose PHOTOELECTRIC REFLECTOMETER

RICHARD S. HUNTER
National Bureau of Standards

ABSTRACT

The multipurpose reflectometer was developed primarily to measure apparent reflectance, specular gloss, and trichromatic coefficients. These measurements are useful in the ceramic, paint, textile, paper, and chemical industries to indicate lightness, gloss, and color of finished articles. In the reflectometer, two light beams from a single source are directed along separate paths to two barrier-layer photocells. Various types of these photocells were studied to find which could be used most advantageously. The reflectometer employs a substitution null method and requires a galvanometer to indicate equality of the currents generated by the two photocells. For each sample tested, there is a photometric adjustment to restore equality of the currents. The amounts of photometric adjustment are measured on the direct-reading scales, one of which is used for apparent reflectance and the other for specular gloss. Because of its high precision, the instrument is well suited for measuring small differences in apparent reflectance, gloss, or color of nearly identical samples. However, for greatest accuracy, it is necessary to correct the scale readings by calibration.

The following dscription has been condensed from the full length paper appearing under the same title in the November, 1940, issues of the Journal of Research of the National Bureau of Standards and the Journal of the Optical Society of America. It is thought that a number of textile technologists who do not ordinarily see the two journals in which the paper originally appeared may be interested in this instrument, in the control of its potential errors, and in the extensive bibliography. Although the paper has been reduced to about one-half of its original length, it is believed that most of the details of interest to textile technologists have been retained.

I. INTRODUCTION

THE multipurpose photoelectric reflectometer is the result of an attempt to combine in one instrument means for measuring (1) 45°,0° luminous apparent reflectance relative to a standard, (2) 45°,0° apparent reflectance relative to a standard through filters for either tristimulus colorimetry or abridged spectrophotometry, (3) four of the six listed types of gloss[15], and (4) the transmission of clear liquids and optical filters having plane parallel faces.

The multipurpose reflectometer is one of a series of null-method instruments developed by the author to measure 45°,0° apparent reflectance relative to a standard. The first of the two earlier reflectometers was a 0°,45° visual reflectometer using a pattern mirror[13]. The aim in building this model was to make a null-method instrument that was simple, could be constructed from inexpensive and readily obtainable materials, and would take relatively large areas of test surfaces. The Committee on Standardization of Tests of the Porcelain Enamel Institute studied this instrument for possible use to measure the apparent reflectances of porcelain-enamel surfaces. They inquired if an instrument of the same character could be photoelectric rather than visual. In answer to this inquiry, two Photox barrier-layer photocells and a galvanometer were substituted for the eye and pattern mirror of the visual instrument, the result being the Photox 0°,45° reflectometer[3, 14].

Following the successful development of a reflectance test[27], in which this Photox reflectometer was used, the same Committee of the Porcelain Enamel Institute turned to the development of tests of porcelain enamels for resistance to acids[28] and to surface abrasion[29]. For these tests, an instrument for measuring specular gloss was required. It was suggested that an instrument for measuring both specular gloss and 45°,0° apparent reflectance would be doubly useful. The first objective of the present project was to design an instrument meeting this dual need.

To develop apparatus suitable for certain colorimetric

measurements was the second objective. In a paper on photoelectric colorimeters, Gibson[9] pointed out that a number of instruments have been developed during the past few years supposedly to measure "color" by means of an illuminant, three spectral filters—usually red, green, and blue—and some type of barrier-layer photoelectric cell. He showed how filters spectrally suitable for photoelectric tristimulus colorimetry ought to be chosen with respect to photocell and illuminant. It is posible to show that, in addition to filters which are properly chosen with respect to photocell and illuminant, a measuring technique capable of unusually high photometric precision is necessary for photoelectric tristimulus colorimetry if the resulting measurements are to identify the smallest color differences of interest[17]. The present paper considers the problem of obtaining high precision, but the selection of proper filters and use of the data obtained therewith are left for subsequent consideration[17].

A third objective was to improve the methods of gloss measurement. In an earlier paper[15], six separate types of gloss were listed, four of which should be subject to photometric measurement. Measurement of specular gloss was required by the Porcelain Enamel Institute; two of the remaining three types, contrast gloss and sheen, have been measured with the multipurpose reflectometer; measurement of absence-of-bloom gloss, the fourth type, has been planned, but not actually tried.

Although not projected in the original plans, a device suitable for measuring the transmission of clear solids and liquids was obtained by making a slight adjustment of the attachment for 75°,—75° specular gloss (sheen). The spectral filters used for reflection measurements are also available for transmission measurement and make possible tristimulus colorimetry and abridged spectrophotometry of transmitting specimens. Inasmuch as many of the so-called colorimetric methods of chemical analysis are simply methods of abridged spectrophotometry, the multipurpose instrument may be used as an analytical instrument for the chemical laboratory.

Measurements of apparent reflectance are both useful and practical. A person viewing a surface never observes it from all directions simultaneously, but from some single direction. An apparent-reflectance value will designate the reflectance which this surface appears to have when viewed from this single direction. Moreover, apparent-reflectance measurements for many conditions, among them 45° illumination and 0° viewing, give results for most opaque surfaces so similar to the true reflectances[26] that they are often used instead. Apparent-reflectance measurements, it should be noted, are more easily made than reflectance measurements, which, for each surface measured, require either many determinations with a goniophotometer and integration to give the final result, or the use of an absolute reflectometer.

Illumination at 45° and normal viewing have been internationally adopted as standard conditions for colorimetry of opaque surfaces[32] because they represent a satisfactory average of the directional conditions under which surface colors are observed in everyday life. Values obtained for the reciprocal conditions, normal illumination and 45° viewing, are by the reciprocity law[26] equivalent to 45°,0° values for the same surfaces.

In the direction of mirror reflection and adjacent directions, the apparent reflectances of surfaces are usually much higher than in other directions. The shininess of surfaces is evidence of this high apparent reflectance.

Barrier-layer photocells possess three advantages for colorimetric and photometric apparatus: (1) The cells are simple and rugged in construction; (2) they generate an emf directly from the light flux incident upon them, so that no externally applied potentials are required for their operation; and (3) they respond more strongly to energy of the visible spectrum than to other energy. On the other hand, there are a number of recognized disadvantages of the cells. Possible methods of compensating for or of overcoming these disadvantages were made the subject of a study prior to designing the reflectometer. A number of cells of different types were investigated under the operating conditions expected in the proposed instrument. The Westinghouse Photox cell[34] was found to be the most suitable when no correcting filter was used in the instrument; the G. E. Light-Sensitive cell[8] seemed to be the best of the cells for use with a filter to give the desired luminosity-function response. This luminosity-function spectral response and the approximations to it provided by the two photocells are shown graphically in Figure 1.

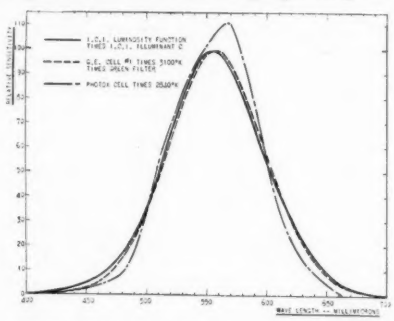

Fig. 1—ICI luminosity function times ICI illuminant C compared with (1) spectral response of GE cell times spectral transmission of green filter times spectral energy of 3,100° K, and (2) spectral response of Photox cell times spectral energy of 2,840° K.

The green filter is Corning 330 Signal Yellow, 2.7 mm of melt of 11-9-31, plus Corning 428 Light Shade Blue Green, 3.5 mm of melt of 11-2-37[4]. (The areas under each of the three curves are equal.)

II. PLAN OF INSTRUMENT

In Figure 2 is a diagram of the multipurpose reflectometer with a partial elevation through **C-C** to show the path of the gloss beam* to and from the gloss surface. The lines indicating both the centers and the edges of the light paths from the source to the respective photocells are

*"Gloss beam" is used hereinafter to designate the pencil of light which is separated from the entrant beam by the small aluminum mirror A, and which ultimately reaches the stationary gloss cell. "Gloss photocell" is used to designate this photocell and "gloss surface" to designate the surface in position to receive the beam at 45° and reflect it at —45° along the path toward the gloss photocell.

heavy. The positions of all elements necessary for the operation of the instrument are shown. The elevated part of the gloss beam between the mirrors A and B is omitted in the plan but is shown in the partial elevation.

The instrument, as has been noted, is designed to operate according to a null method. Light from the single source is divided into two paths, each of which ultimately reaches a barrier-layer photocell. The two cells are connected, with polarities opposing, to the terminals of the galvanometer, giving the current-balancing circuit in Figure 2. The paths followed by the two beams are purposely geometrically different so that different operations may be performed with them. Light diverges from the filament of the projection lamp and passes through a round window in the aluminum insulating shield. Beyond this shield, the beam may pass through one of several spectrally selective filters on a disk and reach the collimating lens mounted in the wall of the instrument housing. The approximately parallel beam leaving this lens then proceeds, in large part, to the vertically placed reflection surface* on which it is incident at 45°. The reflection photocell, to which the scales are attached, "views" the reflection surface from a variable distance.

The plane mirror intercepts a small part of the cylindrical beam and reflects it upward to incidence at 45° on the horizontally placed glass surface. The light reflected by this surface at the angle of mirror reflection, —45°, strikes mirror B, which is in the same place as mirror A. The center of this gloss beam is thereby returned to the horizontal plane and passes through a lens and "gloss aperture," where an image of the source is formed. Behind this aperture is the semidiffusing reflector adjustable in its angular position to control the fraction of light directed from it to the gloss cell. Several different apertures in a disk may be interchanged to vary the spread[18] of the light in the gloss beam passed toward the gloss cell for measurement.

Two scales are ruled on the arm attached to the movable reflection cell, one for reflection, the other for gloss. Stray light, which might register on the photocells, is reduced to a minimum by painting interior surfaces of the instrument a dull black, by mounting the movable reflection cell in a tunnel, and by dividing the instrument interior into compartments separated by the sheet-metal partitions indicated by light dotted lines in Figure 2.

Because test samples may be introduced in either the gloss or the reflection beams and because the gloss beam may be extended above the instrument into attachments for performing additional operations, the multipurpose reflectometer will measure a number of different quantities. For every operation except that of measuring contrast gloss, one beam is made the comparison beam, the other the test beam. Whenever $A_{45°,0°}$ is measured, the comparison surface, which must be permanent in its specular reflection, is placed in the gloss position. Conversely, a surface of which the value of $A_{45°,0°}$ is stable is inserted in the reflection position whenever the gloss beam is used for the specimens to be tested. The comparison specimen, whether it is a mirror or a dark-gray porcelain-enameled plaque, need not be calibrated. The calibrated standard is always one which may be inserted in the instrument in the same position in which the samples are thereafter exposed for measurement, as is customary in all substitution methods.

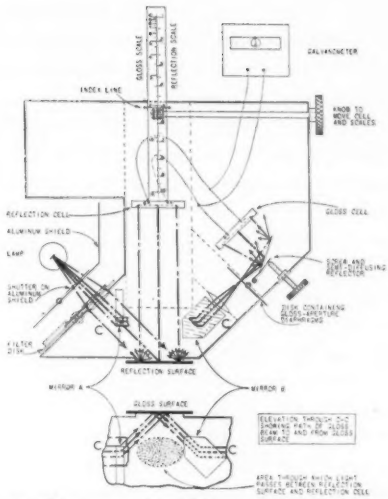

Fig. 2—Diagram of multipurpose reflectometer.

III. CONSTRUCTION

Three multipurpose reflectometers are in use at the National Bureau of Standards, and some of the more important details† of construction of these are given here. The reflectometer shell and interior partitions are of sheet metal, mainly 20-gauge galvanized iron painted inside with matte black and outside with black-crystal finish. The reflectometer body is 40 cm. wide and 16 cm. high. The relative sizes of the compartments and elements within the instrument are rendered accurately in the diagram, figure 2.

Concentrated-filament projection lamps of 100 to 400 watts may be used. The ventilated lamp housing must be thermally insulated from the body of the instrument, but the lamp filament must not move relative to it. In some cases the lamp socket and lamp housing have been mounted on a U-shaped bar attached rigidly through insulating washers to the instrument body. In one case, the body, insulating shield, and lamp socket were mounted on a rigid board which does not readily conduct heat**. However, it has been found that even though the lamp socket be rigidly located relative to the body, movement of the lamp in its socket will sometimes take place during opera-

*Surfaces inserted in this position may be measured for $A_{45°,0°}$. This position of the test sample is hereinafter termed for "reflection position" to differentiate it from the position in which samples are placed for gloss measurement. The beam is termed the "reflection beam," and the viewing photocell is termed the "reflection photocell."

†The detailed plans used in building these instruments may be consulted in the Photometry and Colorimetry Section, National Bureau of Standards.

**The author is indebted to I. A. Balinkin, of the University of Cincinnati, for suggesting this second method of assembling a reflectometer.

tion. Such movement has been found in both the medium-screw-base and medium-prefocus-base sockets which have been tried. Trouble is most likely to occur during the warm-up period, when the instrument has just been turned on and heating causes changes in the parts.

Simple, double-convex lenses 42 mm. in diameter are used (10 diopters for the collimating lens and 20 diopters for the gloss-beam lens). The spectral filters employed are 2 in. square. The small mirror A in the entrant beam is of chrome-aluminum, about 15 mm. square, deposited by evaporation on the end of a thin strip of glass. The mirror B is large, so that its back side will block all light proceeding from the reflection surface toward the gloss photocell. This mirror may be of electrolytically brightened sheet aluminum, chrome-aluminum deposited by evaporation, or other nonselective mirror material. The small circular opening in the disk containing gloss apertures is used for specular-gloss measurements. It is 6.2 mm. in diameter and provides an angular spread* of the gloss beam of 11.7°. For measurements of quantities other than specular gloss, bloom, and sheen, a large circular opening 25 mm. in diameter is used to provide for the maximum angular spread (about 22°) possible with the present lens system. Three openings of this large size are used; two hold "neutral" filters. The 7 by 5 cm. semidiffusing reflector beyond the disk is of electrolytically brightened sheet aluminum; however, a surface painted with aluminum varnish will serve the same purpose.

Both of the instrument openings upon which samples are mounted are oval, 7 cm. long and 5 cm. wide. The samples are placed against a brass collar raised 7 mm. from the shell of the instrument to keep the instrument body and the samples from contact over extended areas. Almost the whole reflection opening is filled by the incident beam; consequently samples for measurements of $A_{45°,0°}$ are required to have flat areas at least 7 by 5 cm. (unless the special device for small areas is used). The gloss beam, on the other hand, covers only a diamond-shaped area 3.8 cm. long and 2.5 cm. wide in the center of the gloss opening, but specimens to be tested must have a somewhat larger flat area a hold against the 7- by 5-cm. elliptically shaped brass collar.

Several auxiliary features may be noted. The clamp which holds the samples during measurement is attached to the end of a spring-bronze arm through a ball and socket so that it will hold specimens of almost any shape firmly in position. It may be used interchangeably over the gloss and reflection openings. Also interchangeable is the movable guide which determines the location on the test piece of the area that is measured. The work of the Porcelain Enamel Institute Committee on Standardization of Tests furnished an example of the use of this guide. It was necessary to measure the specular gloss of the same area of each test piece before and after treatment. By leaving the guide locked in position while etching or abrading a sample it was always possible to remeasure after treatment the exact area initially exposed.

The knob to move the reflection cell, the lever to open the shutter, and a key to reduce the response of the galvanometer are located close together on the rear right side of the instrument, where they may be easily reached by the right hand. A reading lens and mirror enable the operator to read the scales while seated in front of the instrument. The semidiffusing reflector is turned by a thumbscrew conveniently placed in the position indicated by Figure 2. A thumb nut on the shank of this screw enables the operator to lock the reflector in any position desired.

Except when the reflectometer is used for abridged spectrophotometry or with the small rectangular GE photocells, a galvanometer with which one may detect a current of 0.003 microampere is suitable. If, however, the smaller rectangular cells are used with a projection lamp of less than 400 watts, the galvanometer must respond visibly to a current of 0.001 microampere. For abridged spectrophotometry, a galvanometer which will detect with certainty the presence of a current of 0.0001 microampere is needed because of the necessarily low transmission of some of the filters used; the coil of the galvanometer should have a resistance of about 1,000 ohms.

IV. ATTACHMENTS FOR SPECIAL OPERATIONS

The first of the several attachments built to adapt the instrument to special problems is a stand (not illustrated) to lift the reflectometer about 8 in. above the table top and mount it in a vertical instead of a horizontal position so that dry powders or opaque liquids in open pans may be introduced for 45°,0° measurements. When the reflectometer is used in this position, the lamp mounting must be turned, because projection lamps must always be operated with base down.

Figure 3 (*A*) illustrates a device which is used with nonflat surfaces or with surfaces too small in area to fill the full reflection opening. The device consists of a simple lens (20 diopters, 42 mm. diam.) which converges the incident beam to three-eighths inch in diameter at the plane of the reflection surface. During the use of this attachment, a major portion of the incident beam departs significantly from 45° incidence. Since, moreover, nonflat surfaces and surfaces too small to measure in the usual manner are difficult to position accurately for measurement, the apparent reflectances obtained with this attachment are not as accurate as those obtained in the usual manner.

To measure specular gloss at angles other than 45°, attachments of the type shown in Figure 3 (*B*) are mounted on top of the reflectometer and test specimens are placed upon them. By changing the dimensions and the angles of the two mirrors, the type of device may be designed for specular-gloss measurements at any angle desired. Measurements at both 60°, Figure 3 (*B*), and at 75°, Figure 5, have been made with the multipurpose

*For an explanation of what is meant by the spread of a gloss beam see reference [19].

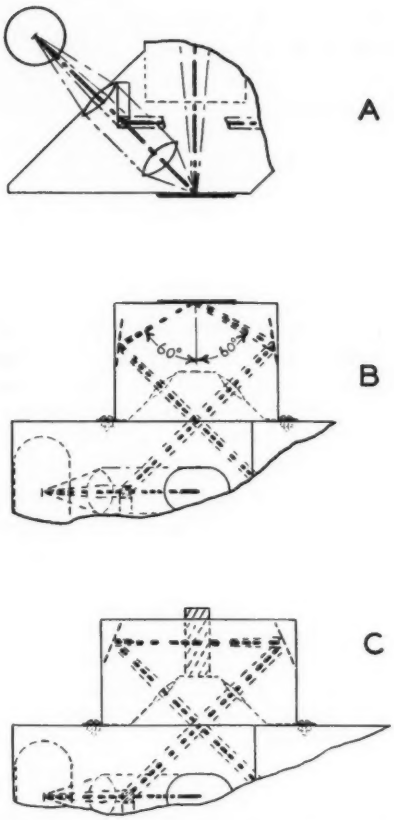

Fig. 3—Three reflectometer attachments for special functions. *A*, For approximate values of $A_{45°,0°}$ of nonflat surfaces and surfaces of small area; *B*, for 60°, —60° specular gloss; *C*, for transmission.

reflectometer. Used with the small gloss aperture, the 60° attachment has been found to give gloss values of painted surfaces in fairly good accord with those derived according to the A.S.T.M. Tentative Method of Test for Specular Gloss of Paint Finishes[1, 18].

For transmission, Figure 3 (*C*), the gloss beam is directed horizontally through the top of the same type of device. Clear liquids in glass cells and clear solids with polished parallel faces are then inserted for measurement.

V. PREPARATION OF THE SCALES

With the multipurpose reflectometer, every setting on an unknown sample is made by moving the reflection cell to a position at which the current it generates balances that generated by the gloss cell. The scales of the instrument are attached to the reflection cell and pass under a ruled index line in the manner indicated in Figure 2. Roughly, the gloss-scale settings vary inversely as the square of the distance between the reflection surface and the reflection cell, and the reflection-scale readings vary directly as the square of this distance.

For the first multipurpose reflectometer, direct-reading scales were prepared using as guides instrument settings on a series of porcelain-enamel plaques of known luminous apparent reflectances. For subsequent reflectometers, printed duplicates of the scales drawn for the first instrument have been used. Although these later instruments have not duplicated the first device in every detail, it has nevertheless proved practical to use the printed duplicate scales and then prepare for each instrument the separate scale-correction curves. The scale errors which must be corrected are, for many conditions, not large. The paragraphs following describe the preparation of the first scales.

A centimeter scale was mounted on the scale arm of the first multipurpose reflectometer in such a position that it indicated the distance from the reflection surface to the reflection-cell face. Null settings were then made on each of the porcelain-enamel plaques of a previously measured white to medium-gray series, and the values of $A_{45°,0°}$ of these plaques were plotted against the distances, giving the dots in Figure 4.

The circles in this figure were obtained from a photometric equation which nearly fits the experimentally determined scale. The fraction of the total flux from one circular disk radiating according to Lambert's law which reaches a second disk of equal radius, both disks being perpendicular to the line joining their centers, is, according to Walsh[33],

$$\frac{F_2}{F_1} = \frac{1}{2r^2}\left[2r^2 + d^2 - d\sqrt{4r^2 + d^2}\right]$$

where r is the radius of the disks, d, their distance apart, F_1 the flux radiating from the face of the first disk and F_2 the flux incident upon the second disk. For an instrument fulfilling the ideal conditions, this equation would serve for spacing the rulings on the scale;* in the present case it proved valuable as a check against the experimental calibration. Setting $r = 2.5$ cm., a series of values of F_2/F_1 were computed relative to that at 33.8 cm. (the distance corresponding to a scale setting of 1.0). The reciprocals of these numbers were plotted in Figure 4 as a function of d. The reflection-scale curve was then drawn through the experimentally determined dots, using the circles to guide in locating the interpolated and extrapolated parts of the curve.

The curve for gloss, also plotted in Figure 4, is the locus of points whose ordinates are reciprocal to the corresponding ordinates of the reflection-scale curve. In measuring gloss, it will be remembered, test sample and comparison surface positions are reversed, hence the inverse relation of the gloss scale and the reflection scale.

The direct-reading scales were ruled from a carefully prepared enlargement of Figure 4. The reflection scale extends from 0.10 to 1.00 and is convenient because of the fairly uniform, open spacing of the scale intervals, evi-

*Failure of this function to apply to the actual instrument arises, in major part, from the presence of stray light, which it is impossible to eliminate entirely, and, to a lesser degree, from the fact that the reflection surface and, in some cases, the reflection photocell are not circular. This failure of the scale to fit Walsh's function is noted in the study of a multipurpose reflectometer by the Institute of Paper Chemistry[23]. They mistakenly assumed in their study that it was intended to have the reflectometer scale fit such a photometric relationship. Actually, in using Walsh's equation, it was intended only to verify in an approximate manner the experimental calibration for interpolation purposes.

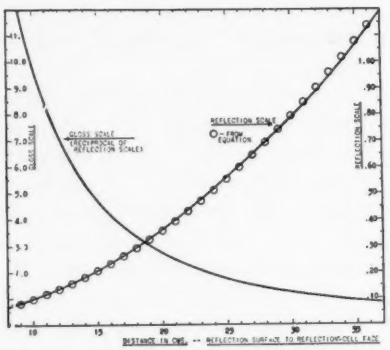
GLOSS SCALE
RECIPROCAL OF REFLECTION SCALE
REFLECTION SCALE
O_c FROM EQUATION
DISTANCE IN CMS. -- REFLECTION SURFACE TO REFLECTION-CELL FACE

Fig. 4—Small-scale copy of the reflection- and gloss-scale calibration curves of one multipurpose reflectometer.
The circles are relative values of F_1/F_2 calculated from Walsh's equation with $r = 2.5$ cm.

denced in Figure 4 by the lack of a marked change of slope of the corresponding curve. The gloss scale extends from 1.00 to 10.0, but the scale intervals are not so uniformly spaced*, in fact, the close spacing between 5.0 and 10.0 makes it often advisable to use a scale setting between 4.0 and 6.0, instead of 10.0, as the 100 per cent setting for transmission measurements. From the carefully ruled pair of direct-reading scales, a zinc etching properly reduced in size was made, and from this etching the scales used in the instruments have been printed.

VI. ELIMINATING OR MINIMIZING ERRORS

Eighteen potential errors in multipurpose reflectometer measurements are listed in Table 1, together with the evidence by which the presence of each is detected and the procedure employed to minimize or eliminate each. The 18 are divided into a group of 12, identified by inconstant operation of an instrument, and a group of 6, the presence of which can only be established by the failure of one instrument to check results from another.

VII. APPLICATIONS OF THE MULTIPURPOSE REFLECTOMETER

The multipurpose reflectometer has high precision and will identify small differences in apparent reflectance, color, gloss, and other properties; but it furnishes only relative, not absolute values. The solution of many problems met in practice requires, however, that the samples of a group merely be exposed for readings from the instrument and then be arranged in order according to the property in question. When this is the case and the samples of a group are similar, the last six sources of error which are so difficult to eliminate may often be ignored. Calibrated standards are not needed. A great saving of labor, in comparison with the amount required for accurate work, is therefore possible.

For quantitative results, a working standard representing the property being measured must be available. This standard should have an assigned value near those of the samples being measured. A substitution method, in which the samples are substituted for, rather than compared with, the standard, is employed. Of the two light paths the one not used for the samples being tested becomes the comparison beam; in it a single uncalibrated specimen is used.

The standard employed for an operation with the multipurpose reflectometer is seldom the primary standard of the property measured, but instead is usually a secondary or working standard which has been carefully calibrated in terms of the proper primary standard. In order to make the variety of measurements possible with the multipurpose device and to have available for any group of samples a standard of similar specifications, a large variety of working standards is needed. In the following description of the operations of the instrument, both the primary standard for each operation and the types of secondary standards most frequently employed are mentioned. These standards are noted in Table 2.

Plaques for secondary standards are, of course, chosen from stable materials. Ceramic materials, because of their relative permanence, are widely used as working standards for apparent reflectance, gloss, and trichromatic coefficients. In certain cases, surfaces of lacquer, paint, plastic, paper, or dry powder are also satisfactory as standards; but

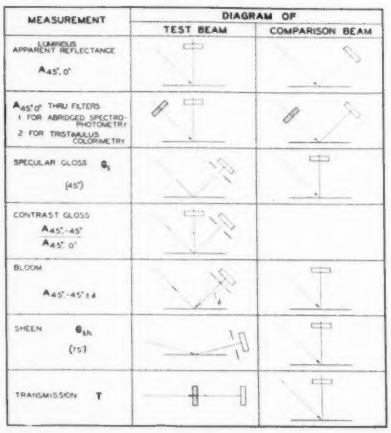

Fig. 5—Different operations of the multipurpose reflectometer showing functions of both the test and comparison specimens for each operation.
(The green filter required with the GE cell for all measurements according to the luminosity function, is not shown).

specimens of any of these latter materials must be checked for permanence before use as standards. Moreover, since several porcelain enamels and ceramic tiles have been found to change color significantly with time, exposure to light, contact with water, or with other treatment, it may be said that each ceramic as well as nonceramic material must be suspected of uncertain permanence until it has proved to be otherwise. However, most porcelain-enamel plaques, blocks of opaque glass, and vitreous tiles used as standards have proved to be stable.

Considering abridged spectrophotometry and tristimulus colorimetry in separate categories, eight different measuring operations can be performed on the multi-

(Continued on page 542)

*It will be found that $-\log_{10}T$, into which transmission (T) is frequently transformed, is more nearly a linear function of scale distance than is T.

• TECHNICAL NOTES FROM FOREIGN SOURCES •

The Reactivity of the Sulfur Linkage in Animal Fibers Part V—Methods of Realizing a Permanent Set at Low Temperatures

Speakman, Stoves and Bradbury—J. Soc. Dyers & Col., 57-73, *March*, 1941.—Three methods of realizing a permanent set in strained animal fibers were described in an article published by J. B. Speakman in 1936. One of these methods was based on the discovery that an aqueous solution of sodium sulfite and sodium bisulfite is effective in promoting disulfide bond breakdown when the sulfites are present in such proportions that the pH value is 6. It was later found that concentrated solutions of sodium bisulfite in alcohol-water mixtures containing 40-50 per cent of alcohol are far more reactive than the aqueous sulfite-bisulfite solution. Disulfide bond breakdown and fiber relaxation are promoted by the reducing agent, and aftertreatment with an oxidizing agent or metal salt causes the necessary linkage rebuilding for permanent set.

The possibility of using metal salts to reform linkage in relaxed structure was established with barium chloride, but the relative merits of different metals and metal salts were not investigated. It is the purpose of the present paper to remedy this deficiency, as well as to discuss the numerous difficulties encountered in the setting process.

Human hair was selected for experiment on account of the uniformity of the fibers along their length. A thoroughly cleaned 5 cm. section was mounted in a specially devised stainless steel apparatus, in which it could be stretched as desired by means of a controlling screw and elongation measured by a traveling microscope. Mounted in the apparatus, the fiber was treated in a sulfite-bisulfite-water-alcohol solution for 15 minutes at 35° C. It was then transferred without washing to a selected metal salt solution for a similar time of treatment at the same temperature, washed, and released for one hour in boiling water. After drying, the dry length was measured and the percentage of set determined.

In order to examine the stability of the new bonds, fibers which had been thus treated with various mineral salts were subjected to the following tests: (A) Boiling under reflux for one hour with 0.1N hydrochloric acid, followed by release in boiling water for one hour; (B) Immersion in 0.1M— sodium carbonate solution for 24 hours, followed by release in boiling water for one hour, or (C) Immersion in H_2S water at room temperature for 3½ hours, followed by release in boiling water for one hour. The fibers were then dried in absence of tension and the residual set determined for comparison with the original set.

In light of the results secured, an extended examination was made of certain metal salts, as well as of several oxidizing agents, with regard to the individual efficiency of the materials in setting highly relaxed fibers, the work being preceded by a general study of linkage rebuilding in such fibers. It was found that of the different metal salts, whose efficiency as setting agents was compared, the best results among the simpler compounds were given by salts of weak acids, such as acetic. The metal itself is not without importance, however, mercury, iron and copper being the most successful of those tested.

If fibers are treated for 15 minutes in concentrated solutions of sodium bisulfite in water-alcohol mixture the disulfide bond breakdown is so severe that the fibers are highly swollen and rubbery. The setting of such highly relaxed fibers presents many difficulties, two causes of which were found to be associated with the high swelling and the molecular disorientation which accompany such breakdown. As regards swelling, improved linkage rebuilding was realized with both oxidizing agents and metal salts when the solutions contained sodium sulfate as swelling depressor. The difficulty of molecular disorientation was overcome by stretching the relaxed fibers to reorient the molecules, but the set imparted by the aftertreatment by oxidizing agents or metal salts was disappointingly low. It was discovered, however, that treatment of the relaxed fibers with ammonia, after extension and prior to oxidation, augmented the degree of set. Equally satisfactory results were obtained by the combined use of ammonia and an oxidizing agent, though the concentration of alkali and the conditions of treatment must be carefully chosen so as to avoid oxidative decomposition of the disulfide bonds formed.

A new method of setting animal fibers at low temperature is thus outlined. The fibers, after treatment with concentrated solution of sodium bisulfite in aqueous alcohol, are washed, and, if not already in the desired configuration, can be deformed and treated with either an alkaline oxidizing agent or a solution of sodium aluminate or tungstate, both containing a swelling depressor. It appears likely that the above principles of linkage rebuilding, applied to the proposed method of Elsässer for setting and lustering wool, will give yarns of sufficiently improved strength to make the process practicable. They may also be utilized to repair fiber damage caused, for example, in bleaching with sodium bisulfite or in stripping dyed material with sodium hydrosulfite.

The article is accompanied by numerous graphs and tables of observations, as well as by a drawing of the stainless steel stretching apparatus used by the authors.

Saponification of Acetate Rayon

Dr. R. Haller—Melliand Textilberichte, XXII, 3, 153, *March*, 1941.—Because of its sharply differentiated chemical and physical properties, as well as its peculiar behavior to dyestuffs, acetate fiber occupies a distinctive position among the commercial rayons. As regards the action of oxidants on this fiber very little information is available. From practical processing experience it is known to be

resistant both to hypochlorite and to peroxide, but a careful examination of its reaction to oxidizing agents, a factor in saponification which should not be neglected, does not appear to have been so far undertaken. As previous work by the author had indicated that saponification of acetate fiber takes place in strata or layers, it was natural that the effects produced on it by action of oxidants should be studied from the same standpoint.

A considerable range of appropriate oxidants is available for examination. It is possible to employ neutral compounds, such as potassium permanganate, acid agents, such as chromium trioxide or hydrogen peroxide, or alkaline agents, such as sodium hypochlorite—though the possibility exists that generally similar results will be obtained.

The author first subjected acetate fiber for 48 hours to the action of a cold 1 per cent solution of chromium trioxide. After rinsing, examination of the strongly colored fiber under the microscope revealed deposits of chromium oxide. Under polarized light the fiber showed double refraction and was faintly luminous. The reaction of ferrous sulfate and ferricyanide for oxycellulose was positive. In cold normal sodium hydroxide solution the fiber deteriorated rapidly and completely; its affinity for substantive dyes was slight in comparison with that of viscose rayon. Thus, for the treatment indicated, no saponification resulted. If the time of treatment was extended to 96 hours a partial saponification could be detected. This appeared upon examination to take place superficially, in layers, the fiber in acetone leaving stringy undissolved residues. The same result was obtained if the fiber was heated for a few minutes to 70-80° C. in the chromium trioxide solution, only a superficial saponification taking place.

If treated with a saturated solution of chlorine dioxide acetate fiber began to saponify only after three or four days, acetone then dissolving all except a thin outer lamella. Heating the reagent did not intensify the saponification. Treated with cold potassium permanganate solution for 72 hours, the greater part of the fiber remained acetone soluble, only a brownish-colored outer layer persisting, in which the deposited Mn_3O_4 was easily detected. After several days' treatment with bromine water, acetone application under the microscope showed that only a fine lamella of the very outer fiber layer had been saponified. No saponification was observed after 3-4 days' treatment of the fiber with a 30 per cent hydrogen peroxide solution. Activin saponified it only very slightly after 72 hours, and the same was true of benzoyl peroxide in aqueous solution.

An investigation was also made of the saponification possibilities of sodium hypochlorite. The resistance of acetate rayon to this reagent, even in concentrated solutions, has already been mentioned. As these solutions, however, are alkaline, it appeared possible that an eventual saponification might result from the alkalinity. The author therefore added acetic acid to a 10° Bé. solution of sodium hypochlorite, so that the free hypochlorous acid might act directly on the fiber. After several days' treatment, however, the acetone solubility remained unimpaired, and no saponification had taken place.

From the above experiments it appeared that saponification of acetate rayon by means of oxidizing agents either cannot be produced, or is produced only with great difficulty, though we know that partial or complete saponification is readily effected by other means.

The swelling effects characteristic of cotton fiber when treated with such reagents as copper ethylenediamine ought also to be obtained from acetate fiber which has been partially saponified in aqueous medium so that an unchanged fiber nucleus remains surrounded by a more or less thick saponified layer. When saponified with N/10 sodium hydroxide solution the fiber on treatment with methylene blue displayed a distinct nucleus of acetyl cellulose. On application of acetone a definite separation of an outer layer could be observed, but there was no evidence of the characteristic bead-like swelling which is shown by the cotton fiber, the saponified layers of the acetate rayon merely floating in the solution without continuity.

It is known that thoroughly cleaned and bleached cotton does not exhibit this spherical or bead-like swelling on treatment with copper ethylenediamine, even though the cuticle has been preserved intact; this phenomenon being due to the presence in the fiber of foreign substances, waxes, pectins, etc., deposited during its growth. It should therefore be possible to create conditions similar to those of the cotton fiber by saponification of acetate rayon, if some foreign substance is intentionaily deposited in the saponified layers.

Acetate fiber was accordingly first saponified by treatment with sodium aluminate, which is strongly alkaline, pressed, and given a further immersion in a solution of aluminum sulfate, by which procedure a certain amount of aluminum was fixed in the saponified area. This fact could be verified by treatment with both alizarin and methylene blue, a distinct double-coloration resulting. On application of acetone, indications of the bead-like swelling could be observed, though the rapid dissolution of the unsaponified nucleus interfered with its full development.

Spherical swelling did not result from treatment with alcohol or an alcohol-benzol mixture. More striking effects were obtained when employing solutions of inorganic salts, such as lithium or sodium iodide and especially potassium rhodanate. If the acetate fiber, first saponified with sodium aluminate and colored with alizarin and methylene blue, was treated with a concentrated solution of one of these salts, there could be observed a slow, irregular detachment of the saponified membrane, which took place in elongated vesicles. Indentations between the vesicles were absent, presumably for the same reason which prevents them in the case of swelling bleached cotton fiber.

Believing this tendency of the saponified outer membrane to separate seam-wise along the length of the fiber, without spherical swelling, to be due to the characteristic corrugated or lapped outer surface of the ordinary acetate

(Concluded on page 546)

PROCEEDINGS OF THE

American Association of Textile Chemists and Colorists

OCTOBER 13, 1941

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CALENDAR OF COMING EVENTS

Meeting, New York Section, Chemists' Club, New York City, October 17th, 1941.

Annual Meeting and Convention, Pinehurst, N. C., October 31st-November 1st, 1941.

Meeting, Southeastern Section, Atlanta, Ga., December 6, 1941.

An Invitation

to attend the Twenty-first Annual Meeting and Convention at Pinehurst, N. C., October 31st and November 1st.

Samuel L. Hayes
General Chairman

Dear Fellow Member:

The Piedmont Section is happy to be host for the Annual Meeting, October 31-November 1. We hope to welcome as many of you as possible in Pinehurst, N. C., at The Carolina, which will be convention headquarters.

Reservations should be made immediately if you have not already done so. Rates at The Carolina will be $14.00 per day for double rooms (double occupancy required), and $8.00 per day single, American plan. There are not many single rooms available. Desirable space is available within five minutes' walk of The Carolina. Rates for these other hotels are about $1.00 per day less, American plan.

The second session of the Intersectional Contest is scheduled for Friday afternoon, October 31. Last year in New York, the Rhode Island Section took the first round, and this year the battle promises to be even hotter and closer. Saturday morning, November 1, will be devoted to technical papers, which are grouped in two concurrent sessions again this year. One, under the able leadership of our Vice-President, T. R. Smith, will be devoted to Hosiery. The other session will be devoted to Textiles and National Defense, under President Carl Z. Draves as presiding officer. Finally, a clinic on "Light Fading" is scheduled with speakers from the two leading manufacturers of fading equipment and also one man giving the user's side of the subject. These technical sessions are being arranged by K. H. Barnard of Pacific Mills.

We are sure you will enjoy your stay in Pinehurst. The Piedmont Section offers a program of entertainment which, in the attractive long leaf pine country of eastern North Carolina, will appeal to every taste. There will be a golf tournament, played on world famous Pinehurst fairways, skeet, bridge, tennis, horseback riding; and a stage show Friday night. The banquet (dress optional) will be held Saturday night at The Carolina, and an outstanding speaker will address the members.

Complete information relative to transportation appeared in the September 15th and 29th issues of the American Dyestuff Reporter.

Meet us in Pinehurst! We shall be glad to welcome you and endeavor to make your stay one that you will remember.

Sincerely yours,

Samuel L. Hayes

General Chairman,
A.A.T.C.C. CONVENTION COMMITTEE

THE SOURCE OF WOOL

and Its Relationship to Wool Dyeing

A Communication

EDWIN G. SUTCLIFFE, B. Ch. E.
Chief Chemist—Samuel Hird & Sons

TECHNICAL men know that wools grown in different localities, although dyed with a constant formulae, are not equally affected by the dye-bath. However the extent of this difference does not seem to be commonly known. The purpose of this paper is to prove that in the case under consideration the only factor effecting the shade of the top is the source of the raw material, then to illustrate graphically the extent of the difference in certain specific cases.

Investigating the cause of uneven dyeing in the dyehouse we found that the unevenness varied from the usual streaky dyeing in that the streaks ran parallel throughout each ball in most cases.

On laboratory investigation, it was found that two types of tops had been blended to form the balls that had been dyed. Both of these tops came from the same Combing Mill. A sample of each top was analyzed for oil content; by running in the soxhlet with ethyl ether for four hours. The results showed 3.33 per cent for top A and 3.43 per cent for top B. The difference in the total amount of oil was so slight that it was evident that the quantity of oil present in the top was not the cause of the difference in shade.

To prove whether the type of oil used in each case might have been the cause of the trouble, dyeings were made on samples of each top before and after extraction with ethyl ether. The results showed that in each case the identical difference existed between the dyed tops before and after extraction.

For further test, the tops were extracted in ethyl ether to remove the oils and then in ethyl alcohol to remove the soaps. The extracted tops were then dyed. Again the same difference existed between the extracted samples as existed between the unextracted samples.

Examination with the projecting microscope revealed that the grade of each sample was fairly close, one being 21.41 microns and the other 20.90 microns.

An investigation of the length, with the standard staple set up as now in use, showed that one top was a good deal longer in staple than the other. Then from the wool buyer we found that one top was an Australian top and the other a territory top.

Checking the pH of the exhaust liquors from the dyeings discussed in this article, with the glass electrode, we find that the maximum variation is 0.3 pH. The dyeings discussed and the pH of the exhaust liquors appear in Table 1.

TABLE 1

Dyeing No.	*pH*	*Temperature*
1368	3.7	82°F.
1367	3.7	82°F.
1419	5.2	76°F.
1421	5.0	76°F.
1420	4.9	76°F.
1418	4.6	76°F.
1377	5.1	75°F.
1370	4.9	75°F.
Undyed Aust.	8.8	75°F.
Undyed Territory	9.2	75°F.

The undyed tops show that the pH of the territory top is 0.3 higher than that of the Australian.

The only varying factor then is the source of the tops.

To further prove that here lay the cause of the trouble, tops were made up containing a definite weight of each type and then dyed. The results checked the theory in that the final shade showed the correct percentage of each color.

In the laboratory 11 tops, including five different samples of Australian tops submitted from various combing mills and six different samples of territory tops from various mills, were dyed using the following constant formulae based on the weight of wool.

0.75% Calcochrome Blue Blk. Conc.
1.00% Alizarine Blue S.K.Y.
0.75% Calcocid Violet Sp.
2.00% Ammonia 25° Be.
6.00% Acetic Acid 56%
4.00% Sodium Sulfate Anhy. Boil 1 hr. 15 min.
1.25% Potassium Dichromate. Boil one-half hr.

In all dyeings discussed in this paper the ratio of water to wool was held constant throughout the tests at 25 to 1.

The dyed samples were easily separated into their different source. The five Australian samples compared with the six territory samples were lighter and bluer. Some variation existed between the different samples from the

TABLE 2

Dyeing No. Wave Length	1368	1367	1419	1421	1420	1418	1377	1370	1700	1701
460	17.34	10.25	4.33	4.92	23.33	24.00	8.00	6.58	10.25	7.75
480	13.08	10.67	4.25	5.50	19.00	21.00	7.08	6.08	8.00	6.92
500	13.25	9.50	4.83	5.17	15.67	16.67	5.00	4.42	5.96	5.08
520	11.17	7.41	4.75	5.00	9.25	9.25	3.67	3.17	4.29	3.67
540	9.58	5.92	4.42	4.75	6.92	6.83	3.00	2.75	3.13	2.91
560	8.16	5.00	4.25	4.92	5.17	5.50	2.83	2.50	2.83	2.79
580	7.50	4.42	4.33	4.92	4.67	4.67	2.75	2.33	2.75	2.58
600	6.25	3.58	4.92	5.00	4.75	4.75	2.58	2.50	2.71	2.50
620	6.50	4.08	6.00	7.16	4.83	5.00	2.67	2.50	3.00	2.87
640	6.50	3.58	7.50	8.92	5.83	5.79	3.25	2.92	3.25	3.21
660	7.16	4.42	10.38	12.32	9.00	8.46	4.16	4.09	4.75	4.54
680	13.32	9.42	14.65	16.75	17.00	17.33	8.25	7.08	9.16	8.67
700	32.34	26.67	20.00	21.33	37.67	33.34	15.25	14.85	22.67	22.67

same source, but this compared with the difference existing between all the Australian and all of the territory was very slight and negligible. All of these tops were approximately the same in grade, varying from 62s fine to 64s. To ascertain if this condition existed at other grades, two tops, one of territory origin and one of Australian origin having an average diameter of 27.5 microns were dyed. The results checked with those obtained in the case of the finer wools.

With the proceeding formulae, which contained both acid and chrome colors, we have proven that the source of the wool has a direct effect on the dyeing. Our next step was to investigate the effect produced with the use of Neolan dyes, Acid dyes, and Chrome dyes. In every case there was a definite shade variation between the Australian top and the territory top.

The following formulae was used with Neolan colors on dyeings No. 1368 and 1367.

1.25% Neolan Blue 2 G
0.75% Neolan Grey B New
1.50% Sulfuric Acid 66° Be.
4.00% Sodium Sulfate Anhy. Boil 45 min.
No. 1368 is an Australian top.
No. 1367 is a territory top.

The resulting colors were tested with the K and E Colorimeter with the following results as shown in Table No. 2. The curves obtained are plotted in figure 1.

We can see from the curves in figure 1 that the territory top dyes a great deal darker and far greener than the Australian does.

The following formulae was used in dyeings No. 1419 and 1421. A chrome color is used in this formulae.

1.50% Alizarol Brown 2R
4.00% Acetic Acid 56%
1.00% Ammonia 25° Be.
3.00% Sodium Sulfate Anhy. Boil 1 hr. 15 min.
0.75% Potassium Dichromate. Boil one-half hr.
No. 1419 is an Australian Top.
No. 1421 is a Territory Top.

The resulting colors were tested with the K and E Colorimeter, with the results shown in table 2. The curves obtained are plotted in figure 2.

We see from the curves in figure 2 that in this case the Australian top dyes darker and bluer brown than the territory top.

Dyeing No. 1367—Territory
Dyeing No. 1368—Australian

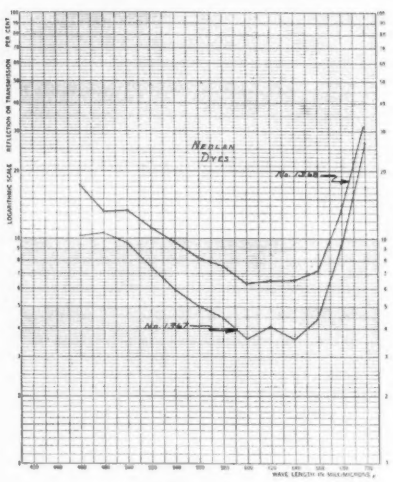


Fig. 1

Dyeing No. 1419—Australian
Dyeing No. 1421—Territory

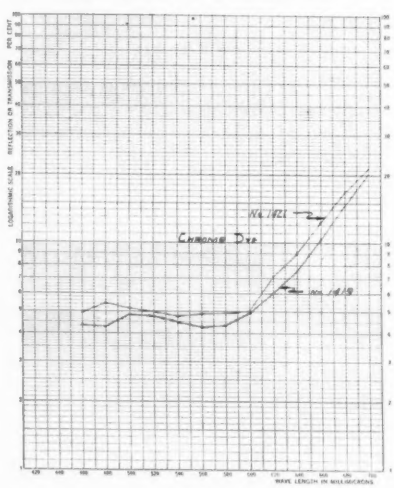


Fig. 2

The following formulae was used with acid colors with dyeings No. 1420 and 1418.

Dyeing No. 1420—Territory
Dyeing No. 1418—Australian

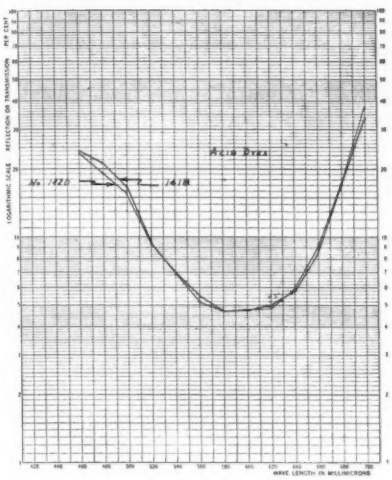


Fig. 3

Dyeing No. 1700—Australian
Dyeing No. 1701—Territory

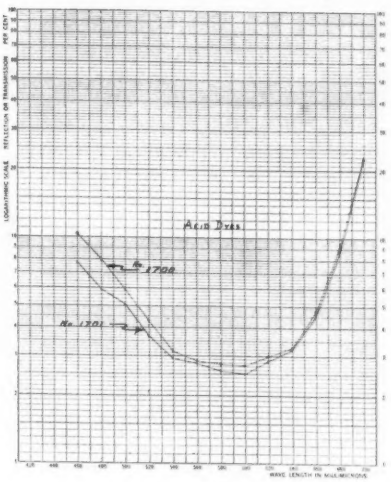


Fig. 4

Dyeing No. 1370—Territory
Dyeing No. 1377—Australian

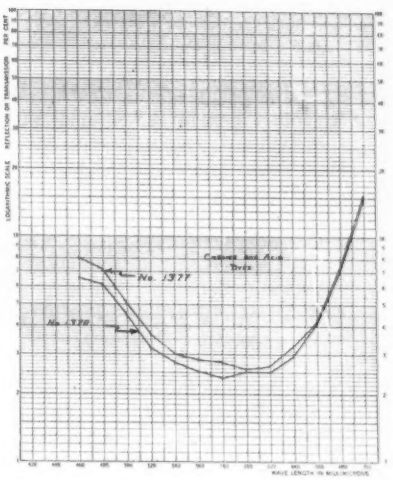


Fig. 5

0.60% Alizarine Blue S.K.Y.
0.15% Calcocid Violet Sp.
4.00% Acetic Acid 56%
1.00% Ammonia 25° Be.
3.00% Sodium Sulfate Anhy.
Boil 45 min.
0.50% Potassium Dichromate
Boil 20 min.
No. 1420 is a territory top.
No. 1418 is an Australian top.

The resulting colors were tested with the K and E Colorimeter, with the results shown in table 2. The curves obtained are plotted in figure 3.

Of all the colors tested this combination shows the least difference between the two tops. In other tests with acid colors, variations as great as those shown with the Neolan colors have been obtained. One such is shown in figure 4. Even in this case, figure 3, there is a noticeable difference. The territory top is redder and slightly darker than the Australian top.

With a mixture of Acid and Chrome colors and the formulae for the same presented in the early part of this paper the results listed under dyeings No. 1370 and 1377 were obtained.

Dyeing No. 1370 is a territory top
Dyeing No. 1377 is an Australian top.

The resulting colors were tested with the colorimeter with the results shown in table 2. The curves obtained are plotted in figure 5.

In this case the territory top dyes darker and redder than the Australian. Redder in the fact that less blue is reflected and therefore the color is purpler than the Australian.

OLIVE DRAB UNIFORM FABRICS

THE special committee of the American Association of Textile Chemists and Colorists, organized to cooperate with the United States Government in an investigation for the purpose of improving the general color fastness of the woolen and worsted Olive Drab Uniform Fabrics, held a meeting at the Chemists' Club in New York recently.

Approximately 500 samples were exhibited representing 150 different dye combinations which had been given weather tests of 10, 20 and 30 days at the Lowell Textile Institute under the direct supervision of B. A. Ryberg, Associate Director of Research for the A.A.T.C.C. Sixteen samples of recent deliveries of O.D. Fabrics received from the Quartermaster Depot and weather tested were included in the exhibit.

The exhibit was carefully examined by the committee members and several other invited guests who had cooperated in the preparation of samples used in this test. It was unanimously agreed that the O.D. Fabric samples submitted by the Quartermaster Depot and weather tested, indicated a very real need for improvement. All of these samples were badly faded and the majority showed undesirable changes in shade.

The process of comparison and elimination was used to reduce the 150 dye combinations submitted, to 5 that appeared to give the most desirable fading characteristics in the 10, 20 and 30 day weather tests. Of the 5 selected, 4 were eliminated for the present because of some question as to the availability of some of the dyes used.

The committee then proposed that a commercial piece of fabric should be prepared using the dye formula selected and exposed to weather for 10, 20 and 30 days along with samples submitted by the Quartermaster Depot. It was also agreed that one of the next best dye combinations should be made up into a commercial fabric and tested at the same time.

Committee members present were: Chairman—L. A. Olney, Director of Research for the A.A.T.C.C.; Secretary—B. A. Ryberg, Associate Director of Research for the A.A.T.C.C.; Representing Textile Manufacturers—Alex. Morrison, American Woolen Co.; John N. Dalton, Pacific Mills; Hugh Christison, Arlington Mills; Werner von Bergen, Forstmann Woolen Co.; Roland E. Derby, M. T. Stevens & Sons Co.; Paul N. Otto, Botany Worsted Mills; Robert O. Dietz, Marshall Field & Co.; Jack Anderson, Peerless Woolen Mills. Representing Dyestuff Manufacturers—Daniel P. Knowland, Geigy Co., representing Swiss Dye Interests; Warren J. Zinck, E. I. du Pont de Nemours & Co.; Wm. R. Moorhouse, National Aniline & Chem. Co.; Henry E. Millson, Calco Chemical Co. Div. of American Cyanamid; E. Appeltofft, General Dyestuff Corporation. Representing the Quartermaster Depot—Frank C. Steadman, Captain, Q.M.C., Assistant. Invited guests—H. P. Selya, Sagamore Color & Chem. Co.; J. W. Monks, Poughkeepsie Dyestuff Corp.; C. H. A. Schmitt, Sandoz Chemical Works, Inc.; J. C. Tebbetts, American Aniline Products, Inc.; H. A. Morrison, Ciba Co., Inc.; O. C. Bartenbach, Zinsser & Co. Representing the Philadelphia Naval Depot—L. Zoole, Chief Chemist, and W. Cranmer, Assistant.

TENTATIVE TECHNICAL PROGRAM

Annual Meeting, Oct. 31-Nov. 1, 1941, Pinehurst, N. C.

FRIDAY, OCTOBER 31, 1941

9:30 A.M.—Council Meeting (135th).

11:00 A.M.—Research Committee Meeting (128th).

2:00 P.M.—Opening of the Technical Session—Introductory remarks by Dr. Carl Z. Draves, President, and Dr. L. A. Olney, Chairman of the Research Committee and "Chief Justice" for the intersectional contest.

Intersectional Contest

2:10-2:30 P.M.—"Progress Report on the Preparation and Processing of Domestic Flax."
South Eastern Section.

2:30-2:50 P.M.—"Evaluation of Finishing Agents for Sanforizing."
South Central Section.

2:50-3:10 P.M.—"Testing Vat Dyed Cotton for Fastness to Hypochlorite Bleach."
Philadelphia Section.

3:10-3:30 P.M.—"Cotton Fabric Constructions in Relation to Water Resistance."
New York Section.

3:30-3:40 P.M.—Intermission.

3:40-4:00 P.M.—"Textile Chemists Meet National Defense Emergency."
Rhode Island Section.

4:00-4:20 P.M.—"Relative Exhaustion of Vat Colors in the Pad Pigment Method of Jig Dyeing."
Piedmont Section.

4:20-4:40 P.M.—"The Prediction and Control of Colored Blends by Optical Means."
Northern New England Section.

5:00 P.M.—Annual Business Meeting.

SATURDAY, NOVEMBER 1, 1941

Session on "Textiles and National Defense"

DR. CARL Z. DRAVES, *Presiding*

9:30-9:50 A.M.—"1941 in the Dyestuff Industry."
Albert E. Sampson, National Aniline and Chemical Company.

9:50-10:10 A.M.—"The Chemical Manufacturer and the National Emergency."
Dr. D. H. Powers, Röhm and Haas Company.

10:10-10:30 A.M.—"Defense Problems from the Mill Man's Viewpoint."
Winn W. Chase, Associate Editor, *Textile World*.

10:30-10:50 A.M.—"Purchase and Inspection of Textiles for the Army."
Lieut. Colonel Vere Painter, Philadelphia Quartermaster Depot.

10:50-11:10 A.M.—"Textiles from the Navy Standpoint."
Lieut. R. G. Buck, SC, Naval Clothing Depot, Brooklyn.

11:10-11:30 A.M.—"Production of Wools of Unusual Properties Through Modification of Their Chemical Structures."
Dr. Milton Harris, Textile Foundation, Bureau of Standards.

Session on "Hosiery"

T. R. SMITH, *Vice-President, Presiding*

9:30-9:50 A.M.—"The Dyeing of Army Socks."
S. M. Hamilton, Holeproof Hosiery Company.

9:50-10:20 A.M.—"The Throwster Serves the Silk Hosiery Industry Without Silk."
George Urlaub, Textile Consultant.

10:20-10:40 A.M.—"The Dyeing of Nylon Hosiery."
P. H. Stott, E. I. du Pont de Nemours and Co.

10:40-11:00 A.M.—"The Manufacturing of Full Fashioned Hosiery in Relation to the Finish."
Joseph Kelly, May Hosiery Mills.

11:00-11:20 A.M.—"The Dyeing and Finishing of Full Fashioned Hosiery."
Virgil T. Hartquist, Wayne Knitting Mills.

11:20-11:40 A.M.—"The Hosiery Situation Today and Outlook for Tomorrow."
Earl Constantine, President, The National Association of Hosiery Manufacturers.

"Light Fading Clinic"

DR. CARL Z. DRAVES, *Presiding*

12:00-12:15 P.M.—"Fundamental Concepts in Fade-Ometer Design and Operation."
E. H. Harvey, Atlas Electric Devices Company.

12:15-12:30 P.M.—"The 'National' Accelerated Fading Unit."
C. G. Ollinger, National Carbon Company, Inc.

12:30-12:45 P.M.—"Action of Accelerated Fade-Tests on the Color of Wool Fabrics."
J. J. Glen, Sidney Blumenthal Company, Inc.

1:00 P.M.—Luncheon for Officers of the Association and its Sections.

Entertainment at the Annual Meeting and Convention —

L. M. Boyd
Chairman, Entertainment Committee

The Piedmont Section of the A.A.T.C.C. is fortunate in having a past master in charge of their Entertainment Committee in Louis M. Boyd of Scholler Bros., Inc. Mr. Boyd is also Chairman of the Piedmont Section. The Entertainment Committee includes the following:

Hobart Souther—Proximity Print Works.
Herman A. Walker—Morganton Full-Fashioned Hosiery Co.
R. H. Tuttle—Marshall Field & Company.
Chester Cobb—Arnold Hoffman & Company.

The entertainment will be given at the local theater in Pinehurst in order to properly accommodate all of the members who will want to enjoy this part of the recreation provided for those who come to the convention. Your worries regarding shortages, delayed deliveries, and other business problems will completely pass from your conscious mind when you relax and enjoy the many recreational and entertainment programs provided for you at Pinehurst.

Pinehurst, N. C., - October 31st - November 1st
Auspices of the Piedmont Section

Twenty-first

ANNUAL MEETING AND CONVENTION

—RESERVATIONS—

If you have not made your reservations for rooms and sport activities at Pinehurst, **DO IT NOW** through—

D. Stewart Quern
Chairman, Reservation Committee
1930 Harris Road
Charlotte, N. C.

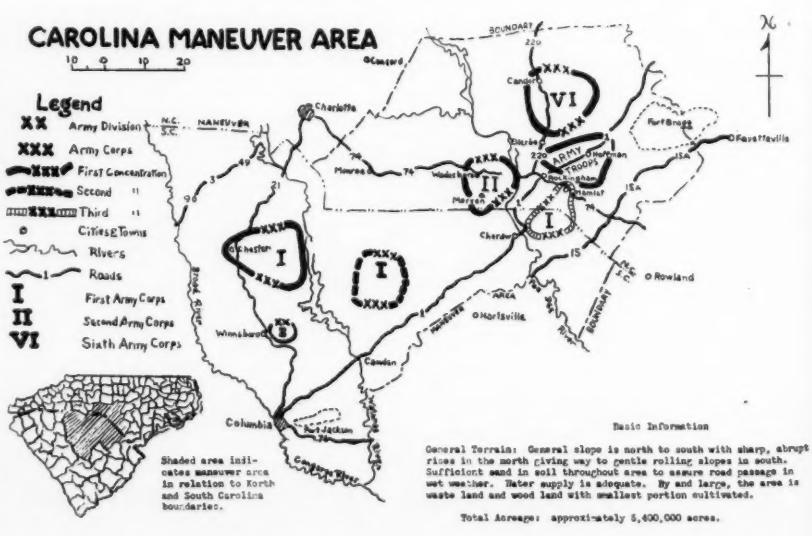
See issue of August 18th
AMERICAN DYESTUFF REPORTER
for hotel rates.

PINEHURST, N. C.
OCT. 31 — NOV. 1

NOTICE TO THOSE MOTORING TO PINEHURST

War maneuvers of the 1st, 2nd, and 6th Army Corps will be in progress during the convention at Pinehurst, October 31 and November 1. These maneuvers will handicap the travel of motorists coming to Pinehurst at that time, unless they use a road which will outskirt the maneuver areas shown on the adjacent map of North Carolina and South Carolina.

We suggest that you consult the road authorities in your locality for the correct information on which roads to avoid if you plan to motor to Pinehurst. Motor travel will be very slow if you are obliged to go through the areas of maneuvering and many of the roads may be blocked off during such maneuvers.


CAROLINA MANEUVER AREA
Legend
XX Army Division
XXX Army Corps
First Concentration
Second "
Third "
Cities & Towns
Rivers
Roads
I First Army Corps
II Second Army Corps
VI Sixth Army Corps
Charlotte
Columbia
Camden
Wilmington
Fayetteville
Rowland
Shaded area indicates maneuver area in relation to North and South Carolina boundaries.
Basic Information
General Terrain: General slope is north to south with sharp, abrupt rises in the north giving way to gentle rolling slopes in south. Sufficient sand in soil throughout area to assure road passage in wet weather. Water supply is adequate. By and large, the area is waste land and wood land with smallest portion cultivated.
Total Acreage: approximately 5,400,000 acres.

A Micro-Analytical Method for the Detection and Estimation of Certain

TEXTILE FINISHES

W. WENDELL RAZIM
Onyx Oil & Chemical Company

THE method described below is a general method for the detection of protein and protein-like substances on cellulosic fibers and might find numerous applications. However, the most useful specific application to the textile industry would probably be the detection of gelatin on rayon after a scouring operation. This scouring or desizing operation is preliminary to dyeing, and if incompletely or inefficiently performed, may result in unlevel dyeings, spotting, adverse final hand, etc.

The rayon piece goods, as the dyer receives them, may contain plasticizers and lubricants such as oils and waxes, hygroscopic agents, sizes such as gelatin or starch, dirt incidental to handling, etc. Gelatin, however, is one of the chief impurities and the contaminant most likely to undergo chemical change during ageing. This change frequently results in the production of an insoluble or difficultly dispersible body and produces various dyeing and finishing troubles.

The etiology of these defects is frequently difficult to determine by existing standard methods of analysis. The methods in common use are either inconvenient, require special technique, do not detect traces, require too large a sample, or are only qualitative. Such methods are the biuret test, the Xanthoproteic acid test, the sodium fusion test, Kjeldahl determination, extraction and precipitation methods, hydrolysis and subsequent amino-acid detection, etc.

It has been found, however, that gelatin and protein bodies have a potent affinity for certain classes of dyestuffs. Many of these dyestuffs are devoid of tintorial action on cellulosic materials. Hence, by simply setting the protein on the fabric and exposing the fabric to the requisite dye solution, an apparent dyeing is produced and the presence of a protein or some similar dyeing body shown.

This is the essence of the proposed method and the principal work done in developing and establishing the method may be briefly outlined as follows:

A swatch of viscose-acetate satin was carefully scoured. Half of this was set aside as a "blank." The other half was treated with a gelatin solution and made to contain 1 mg. of gelatin per cm². This was dried and set aside as a "control." Trial tests were now made on small pieces of these samples, taking the precaution to give both the blank and the control, identical treatment. This was accomplished by submitting both the blank and the control to the same fixing, dyeing and rinsing baths, and for the same duration.

The first line of research was for a suitable dye. The dark blues, navies, purples, and violets were first investigated, and these were chosen from dyes expected to have relatively little affinity for cellulosic fibers, but great affinity for protein and protein-like substances. A number were tried but Formyl Violet S 4 B was the most successful.

The testing method consisted in treating small pieces of both the blank and the control with formalin for 10 minutes at 25° C. They were then dried with heat and rinsed several minutes in running tap water. The next step was to dye them at the boil in a 0.1 per cent solution of the dye for 15 minutes with proper agitation. Two sets of dyeings were made with each dyestuff. The first was a neutral dyeing, while the second contained 0.5 per cent acetic acid.

These experiments indicated that Formyl Violet S 4 B was best suited for the purpose. This dyestuff is the sodium salt of dibenzyl-tetraethyltriamino-triphenylcarbinol disulfonic acid anhydride ($C_{41}H_{44}N_3O_6S_2Na$), and has a Colour Index Number of 698. It is described in Schultz's Farbstofftabellen under Number 530.

The conditions of dyeing and rinsing were now investigated and the following observations made:

1.—Acid dyeings are preferable to neutral dyeings.
2.—Lower concentrations of dye than that mentioned above yield superior results.
3.—Long period dyeing at 60° C. is unsuitable.
4.—Dyeings made at the boil for 15 minutes give optimum results.
5.—Acid rinses are preferable to neutral rinses.
6.—The rinse should be at about 60° C. and for at least 5 minutes.

Applying the optimum conditions, noticeably more intense dyeings were had with the control than with the blank, and thus it was demonstrated that quantities of gelatin as low as .01 mg., and spread over an area of 1 cm² could be detected.

(Concluded on page 545)

PHOTOELECTRIC REFLECTOMETER

(Continued from page 530)

purpose reflectometer. These are shown schematically in Figure 5 by the directions in which the test and comparison beams strike and leave the test and comparison samples respectively. For each of the operations there are several applications, a number of which are listed in table 2. The table also gives data to assist one in arranging the parts of a multipurpose reflectometer for operation and lists the primary and working standards for each

TABLE 1
Errors in Multipurpose Reflectometer Measurements, Their Causes and Control

Evidence of presence of Error	*Cause of Error*	*To Minimize or Eliminate the Error*
A. ERRORS EVIDENCED BY INCONSTANT OPERATION OF SINGLE INSTRUMENT		
From Characteristics of the Photocells		
1. Change of settings with temperature of instrument.	Change of photocell current with temperature.	Allow instrument to warm up to equilibrium and check with standard frequently to detect drift.
2. Galvanometer drift after opening shutter.	Change, with time, of current from one photocell relative to that from the other (fatigue).	Use photocells paired for equal rate of drift and thus eliminate residual drift.
3. Galvanometer response to change of line voltage.	Change with source intensity of current from one photocell relative to that from the other.	Use photocells paired for like changes of current with identical changes of illumination.
4. Persistent failure of instrument to reproduce readings made shortly before; galvanometer drift.	Failure of contacts within photocells.	Renew electrical contacts within cells, or replace cells.
From Design of the Instrument		
5. Galvanometer response to movement of a light past cracks and openings in the instrument.	Light leakage	Make housing light tight, or use instrument in a darkened room.
6. Galvanometer response to pressure on, or movement of, instrument during a setting.	Lack of structural rigidity	Build instrument rigidly; handle carefully during use.
7. Erratic operation	Dirt on optical parts	Clean parts affected.
From Characteristics of the Sample		
8. Galvanometer response to change of line voltage only when instrument beams have markedly different spectral composition.	Marked spectral difference of samples in two beams.	Operate source at constant voltage when beams have markedly different spectral composition.
9. Change of instrument reading with change of area of surface exposed.	Nonuniformity of surface of the sample in the quality being measured.	Designate area of surface measured.
10. Change of instrument reading with wobble of surface over opening.	Nonflatness of surface of sample.	Flatten surface or designate exact position during measurement.
11. Change of instrument reading with rotation of sample surface.	Variation of apparent reflectance of surface with rotation in its own plane.	Make and average four readings of sample rotating it 90° between each pair of readings.
12. Change of reading with exposure of sample to light, time, humidity, or other treatment.	Impermanence of characteristics of sample.	Treat sample so affected with care and give history prior to measurement.
B. ERRORS IDENTIFIED BY USE OF SEPARATE INSTRUMENTS		
13. Failure of reflectometer to check accurate results from separate instruments.	Inaccurate scales	Prepare and use scale-correction curves following instructions.
14. Failure of reflectometer to check accurate results from separate instruments.	Inaccurate calibration or change of standard.	Remeasure standard.
15. Failure of reflectometer to check accurate results from separate instruments (frequently appears when results are compared with those from instrument of different type).	Inexact duplication of specified directional conditions of measurement.	Examine angular conditions of measurement of both instruments involved. (Do not expect accurate duplication of results if there are differences.)
16. Failure of reflectometer to check accurate results from separate instruments. (Penetration of light is often visible at edges of sample.)	Loss of light by lateral passage after penetration into translucent sample.	Measure on instrument having negligible penetration loss.
17. Failure of reflectometer to check accurate results from separate instruments.	Failure of spectral response of source-filter-photocell combinations to duplicate those required.	Use standards spectrally similar to samples measured.
18. Failure of reflectometer to check accurate results from separate instruments.	Fluorescence of samples	Samples must be measured on instrument not subject to fluorescence error.

TABLE 2
The Measuring Operations of the Multipurpose Reflectometer, Some Applications of Each, Arrangements for Operation, and the Standards Used

	Applications	*Arrangements for Operation*					*Standards*	
Quantity Measured	(The references are to papers illustrating each type of measurement, not in the majority of cases to use of the multipurpose reflectometer.)	*Position of Sample*	*Scale Used*	*Comparison Surface*	*Gloss Aperture*	*Spectral Filters*	*Primary*	*Working*
Luminous apparent reflectance, $A_{45°,0°}$.	To test paints, etc., for compliance with $A_{45°,0°}$ specifications[7]. To measure opacity and hiding power[23]. To measure cleaning power of soaps and detergents[5]. To determine lightness of surfaces (for Munsell value[11]). To measure $A_{45°,0°}$ of blacks[13].	Reflectance.	Reflectance.	Aluminum mirror.	Large	Luminosity (green); (none with Photex cell).	MgO	White, gray, or black porcelain-enamel or other ceramic surface.
Tristimulus colorimetry of surfaces), $A_{45°,0°}$, through three filters.	To furnish trichromatic coefficients[17]..... To measure amount and indicate character of color differences[16, 17, 24]. To measure whiteness, yellowing, fading, bleaching, amount of bluing, tinting strength, etc.[21].	Reflectance.	Reflectance.	Aluminum mirror.	Large	Green blue, and amber tristimulus filters.	MgO	Porcelain-enamel or other ceramic surface similar in color and spectral character to samples.
Abridged spectrophotometry (of surfaces), $A_{45°,0°}$, through filters.	To supply approximate spectral-reflection curves[20]. To supply apparent reflectances for selected wave lengths[2].	Reflectance.	Reflectance.	Aluminum mirror.	Large	Selected filters transmitting narrow spectral bands.	MgO	Ceramic plaque of known spectral 45°, 0° apparent reflectance.
Specular gloss, $G_s(45°)$	To indicate shininess of surfaces[12]. To furnish a measure of the resistance of surfaces to abrasion, acid attack, weathering, wear, etc.[28, 29]. To classify paints and other materials for gloss[18].	Gloss	Gloss.	Black plaque..	Small	Luminosity (green).	Perfect mirror.	Polished black glass or surface of liquid of known refractive index.
Contrast gloss, $\frac{A_{60°,-45°}}{A_{45°,0°}}$	To determine the glossiness of surfaces of low gloss[15]. To measure papers for power to produce glare[22].	Reflectance.	Gloss or reflectance.	None	Large	Luminosity (green).	Mirror ...	Matte surface measured on goniophotometer.
Bloom, $A_{45°\ -45°\pm\delta}$..	To measure the bloom of surfaces of high gloss[25].	Gloss	Gloss	Black plaque..	Special ...	Luminosity (green).	Perfect mirror.	Polished surface of opaque white glass.
Sheen, $G_{sh}(75°)$	To measure sheen or the shininess of surfaces at near-grazing angles[10].	On special attachment.	Gloss	Gray plaque..	Small	Luminosity (green).	Perfect mirror ..	Polished black glass or surface of liquid.
Transmission	To measure luminous transmissions[10]..... To measure abridged spectral transmissions[6]. To furnish trichromatic coefficients for transmitting specimens[17]. To supply data for chemical analyses ("chemical colorimetry")[6, 30].	On special attachment.	Gloss	Light-gray plaque.	Large	All filters (Choice depends on use).	Air, or solvent in cell.	Air, solvent in cell, standard solution, or spectral filter of known spectral transmission.

operation. Table 3, by illustrating the measurement of the 45°,0° apparent reflectance of four porcelain-enamel plaques, demonstrates the form used at the National Bureau of Standards to record and reduce data for six operations.

TABLE 3
Form Used at the National Bureau of Standards for Recording and Reducing Multipurpose Reflectometer Data
[Figures in bold-face type are entered to illustrate the determination of $A_{45°,0°}$ of four porcelain-enamel plaques]

Type of measurement:
- x(1) 45°,0° luminous apparent reflectance
- (2) 45°,0° apparent reflectance through filters
- (3) 45°,—45° specular gloss
- (4) 60°,—60° specular gloss
- (5) Sheen (75°,—75° specular gloss), or
- (6) Transmission, luminous or through filters

Samples—**4 porcelain-enamel plaques.** ... Settings by **RSH, 5/25/40.**
From—**Colorimetry Section, NBS.** Computations by **RSH, 5/25/40.**
NBS Test No. ..... Checked by **DBJ.**

Standard—**Vitrolite No. 1.** Value assigned standard..... **0.909**
Mean of corrected instrument readings of standard.... **.905**
Ratio of above two values equals *adjusting factor*..... **1.0045**

	Standard	White 1	White 2	Gray	Black
Samples					
NF factor	...	...	...	0.479	0.086
Settings	0.909	0.736	0.809	.2504	.1264
	.901	.732	.807	.2495	.1264
Mean (M)	.905	.734	.808	.2500	.1264
Correction	.000	+.0025	+.0028	—.0114	—.0360
Corrected M	.905	.7365	.8108	.2386	.0904
Times NF factor...	...	....	....	.1148	.00778
Times adjusting factor	.909	.740	.814	.115	.0078

Spectral filters used—**green (luminosity)**

Neutral-filter (NF) factors when green filter used: Refl. scale ..... 0.479, 0.086; Gloss scale 2.09, 11.6

To extend the 1-to-10 range of the scales of the instrument for any measurements in which the small aperture is not used, one of two neutral filters is inserted in the gloss beam by turning the disk containing gloss apertures. With the insertion of either filter, the values of $A_{45°,0°}$ measured from the scale are multiplied by, or the values of transmission or gloss are divided by, the transmissions of the filters. For the two filters in the instrument in the Colorimetry Section, National Bureau of Standards, the transmissions are:

Nominal Transmissions of "Neutral" Filters	*Exact Transmissions of "Neutral" Filters*		
	For Green Tristimulus Filter (Giving Luminosity Function)	*For Blue Tristimulus Filter*	*For Amber Tristimulus Filter*
0.5	0.479	0.427	0.480
.1	.086	.065	.088

These two filters were used in the operation illustrated in Table 3 (where they are identified by "NF factors"), in which a gray and a black plaque together with two white plaques were measured for $A_{45°,0°}$ relative to a white standard. Instead of following the procedure illustrated, the gray and black plaques could have been measured against gray and black standards, respectively, and the neutral filters would not then have been required. There are many instances, however, where these filters are necessary. In tristimulus colorimetry, for instance, selective samples are frequently encountered which cannot be measured without the use of one or both of them. An orange-colored sample, as an example, might require that the reading for amber light be made with no filter, the reading for green light be made with the "five-tenths" filter, and the reading for blue light be made with the "one-tenth" filter.

When necessary precautions are taken, the multipurpose reflectometer may be made to operate with high precision; when proper standards are used and corrections applied, accurate results may be obtained. It is believed that the instrument will prove especially well suited for the measurement of small differences in lightness, color, and gloss between samples which are nearly identical.

VIII. REFERENCES

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Textile Finishes—

(Concluded from page 541)

Foundations for the method now being established, the author next turned to refining the procedure. A study was made of the "fixing" operation. No decided advantage was had in diluting the formalin, or warming it. However, when tannic acid was substituted for the formalin, a striking contrast was had between the control and the blank.

The method was now tested on smaller quantities of gelatin. Two pieces of viscose satin were impregnated with gelatin to contain 0.0074 mg/in^2 and 0.074 mg/in^2 respectively. The difference in dyeing of the former and the blank was very noticeable, while the contrast between the latter and the blank was truly remarkable.

Limitations of the Method

It should be obvious, however, that the method is not specific for gelatin, but would also give positive results with any other substance to which the dye would be substantive, and which would be fixed to the fiber. This would include proteins "tanned" by the fixing treatment, and would also include certain cation-active textile finishes. It would thus be useful for estimating the take-up of any of these substances. For example, a swatch containing .074 mg/in^2 of casein gave a strongly positive result. And thus, while a positive result is not a sufficient condition for gelatin (or casein, etc.), it is a necessary one, and may be used to determine any one of these substances (gelatin, casein, etc.) when interfering substances are known to be absent. Also, it may be used to establish the absence of such substances.

The following claims are made for the method:

1.—That it is a simple micro-method, requiring no special micro-technique.

2.—That it requires no special laboratory equipment.

3.—That it is semi-quantitative, (if the "unknown" is treated together with a blank and several "knowns" or standards containing known concentrations of gelatin (or casein, etc.), the concentration on the "unknown" swatch may be semi quantitatively determined by matching the intensity with the "knowns.")

4.—That it might be used for solutions of gelatin (or of casein, etc.) by impregnating a rayon swatch with the solution, drying it, and proceeding as above. (This, too, may be semi-quantitative if the takeup of the solution be observed).

5.—That it may be used for determining the quantity of certain "permanent" cation-active textile finishes remaining after various washing, rinses, etc.

Resume of the Method

The optimum procedure was found to be as follows:

Small pieces (3 inches square or smaller) of the blank, the unknown and the standards are placed in about 600 cc of a 5 per cent tannic acid solution at room temperature and constantly agitated for 15 minutes. They are then removed and dried with heat. They are now rinsed in water at about 40°C. and in running tap water for several minutes.

The next step is to dye them. For this purpose, a stock solution is prepared according to the following formula:

Formyl Violet S 4 B (C. I. 698)	1 gm.
Glacial Acetic Acid	20 gm.
Water	to make 1 liter

The dyebath is conveniently made by adding 60 cc of this reagent to 540 cc of water. The dyebath is heated to boiling and the swatches introduced. The bath is maintained at this temperature and the swatches agitated for 15 minutes. They are now removed and placed in a rinsing bath at 60°C. and agitated for 5 minutes. This rinsing bath is made by adding 60 cc glacial acetic acid to 540 cc water.

The swatches are finally rinsed for several minutes in running tap water, squeezed, and dried.

(NOTE: The author has been unable to find any similar method for the detection of gelatin (casein, etc.) in the literature and would welcome any information of such previous work from his readers.)

Acknowledgment

The author wishes to acknowledge his indebtedness to Dr. H. H. Mosher of Onyx Oil & Chemical Co.'s laboratory, for his very valuable assistance in preparing the manuscript.

Technical Notes—

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fiber, as shown in microscopic cross-section, the author experimented with an acetate fiber of circular section which is made by Ciba (D. R. P. 560,036), employing a wet-spinning process. When this fiber, superficially saponified by means of a boiling 10 per cent solution of sodium aluminate, was treated first with a solution of iodine in potassium iodide and then with 60° Bé. sulfuric acid, a well defined spherical swelling resulted.

When the iodine treated fiber was thus brought into contact under the cover glass with concentrated sulfuric acid there were first observed vesicle-like extensions, caused by the nucleus breaking through the unaltered saponified lamella. Then restrictions were formed between the swellings, and after some time the typical bead-string effect became evident, just as in the case of native cotton treated with copper ethylenediamine. In this instance the saponified exterior lamella was not at first attacked by the acid. The inner nucleus of acetyl cellulose, however, was rapidly swelled by the diffusing acid, expanding through and disrupting the outer layer. The differentiation between inner and outer layer was easily recognized, as on contact with the acid the iodine treated outer layer was colored blue, while the swelling nucleus of acetyl cellulose was ruby red, changing to blue only after long exposure.

This investigation has shown clearly the conditions under which the bead-like swelling of cotton fibers takes place. Though undoubtedly the particular swelling agent used plays some part in the action, primarily it is dependent upon the concentric arrangement in the fiber of two layers of differing behavior. The action is furthered by a circular fiber section, which permits uniform swelling in all directions. These conditions for swelling have now been reproduced in a purely synthetic product, and will in future have to be taken into account in diagnostic analysis of new fiber material.

The article is accompanied by three photomicrographs, showing respectively the cross-section of ordinary acetate fiber, the "string-of-beads" swelling effect produced when the iodine-treated fiber is acted on by sulfuric acid, and the different colorations resulting in outer layer and inner nucleus from the acid action.

Colorimetric Determination of Sodium Hydrosulfite

J. Lotichius—J. Soc. Dyers & Col., 56-434, *Oct.*, 1940. —From a previously described method of determining Indigo colorimetrically it is possible to derive a colorimetric method for the determination of sodium hydrosulfite.

An accurately weighed quantity (about 0.5 gr.) of the sodium hydrosulfite to be tested is brought together in an air-free flask with excess of both Indigo and caustic solution. The reduction proceeds quantitatively, 1.0 gr. of Indigo being reduced by 0.66 gr. of $Na_2S_2O_4$. When the reaction has terminated and excess unreduced Indigo settled out, 10 cc. of the solution are pipetted off, mixed with 10 cc. of protoalbinate solution, oxidized with hydrogen peroxide and made up to 100 cc. When the sol has been adequately diluted, its color intensity and consequently its Indigo concentration may be colorimetrically determined by comparison with a standard solution, and from this the $Na_2S_2O_4$ content of the sample may be calculated.

The accuracy of this method was checked by comparison with Bosshard and Grob's modification of Schützenberg and Risler's method for determining sodium hydrosulfite, and found to give results in good agreement.

By applying the present colorimetric method it is possible to determine in a simple manner the hydrosulfite content of Indigo-alkali-hydrosulfite vats. With this end in view the Indigo content of the vat is determined by the author's colorimetric method. A sample of liquid drawn from the vat is then treated in a bottle from which air is excluded with a definite amount of pure 20 per cent Indigo paste and additional caustic. After 45 minutes the Indigo content of the liquid is again determined colorimetrically, and the sodium hydrosulfite content calculated, 0.66 being used as the conversion factor for Indigo to sodium hydrosulfite. In a good vat this concentration should amount to from 0.5-1.0 gr. $Na_2S_2O_4$ per liter. Varying quantities of Indigo and caustic soda added do not influence the results of the determination.

A New Durable Dress Fabric of Bemberg Crepe

Melliand Textilberichte—22, 3, 133, *March*, 1941.—Under present circumstances dress fabrics have to meet requirements differing from those which prevail in time of peace. Normally the attempt is made to place upon the market materials which have fashion appeal, and which are distinguished at least as much by their fineness and attractive appearance as by their wearing qualities.

Among fabrics strongly favored in peace time an important place has been held by "Bemberg-Lavabel," constructed of 80 den. Bemberg crepe warp and 80 den. plain Bemberg Matese filling. This material has enjoyed unusual popularity, and cannot well be omitted from any list of fashionable print goods.

Recently there has been developed another Bemberg product of this type which has the added advantage of durability, being about 70 per cent heavier than the "Bemberg-Lavabel." The main construction features of the new fabric may be given as follows: Gray Width—108-110 cm.; Finished Width—(about) 90 cm.; Warp—13,5/2 twist, 27 threads per cm., 180 den. Bemberg crepe, 1 "S" twist, 1 "Z" twist; Filling—22 threads per cm., twistless natural lustre Bemberg.

By employing coarser yarns a fabric is produced which has a granular, jersey-like appearance, a quality which tends to increase its attractiveness and will contribute to its success. It also possesses the advantage, so important in dress materials, of being practically creaseless and therefore requiring no special aftertreatment for this purpose. Its production is said to involve no particular difficulty.

TRADE NOTES • NEW PRODUCTS

• TEXTILE RESEARCH PROGRAM

An important step in the projection of a long-range research program has just been concluded through a conference between representatives of the U. S. Institute for Textile Research and the research staff of the Textile Foundation, held at the National Bureau of Standards in Washington. This followed other meetings between the Institute and research men in the textile industry, and will be followed by similar conferences in the future, leading up to the completion of the plan for presentation at the Institute's annual meeting in November. It was in line with the new working arrangement between the Institute and the Foundation, concluded recently.

At the Washington conference, the possibilities for practical application of the basic studies of the Foundation's staff were explored, and means to make those results available to the industry at large were discussed.

It will be the U. S. Institute's job to provide a channel between the laboratory and the mill. It was the consensus at the meeting that, for the first time since the start of organized, cooperative research in the textile industry in 1930, there now is a chance to make the program a working tool in future textile development. It was also agreed, however, that to achieve that end, the active support of all groups and all individual companies is essential. The enlistment of such support will be the first job of the officers and committees of both the Institute and the Foundation.

Representatives of the U. S. Institute at the Washington meeting included F. S. Blanchard, of Pacific Mills, president; Fuller E. Callaway, Jr., of Callaway Mills, vice-president; Dr. Harold De Witt Smith, of A. M. Tenney Associates, treasurer; E. T. Pickard, executive secretary; Douglas G. Woolf, editor of *Textile World*, a member of the steering committee; William D. Appel, of the National Bureau of Standards, chairman of the Industrial Research Committee, and three members of his committee, E. R. Schwarz, of Massachusetts Institute of Technology, vice-chairman; Dr. A. C. Walker, of Bell Telephone Laboratories, and W. O. Jelleme, of Pacific Mills; also William W. Carman, Jr., of the U. S. Department of Commerce, a member of the Economic Research Committee.

Representatives of the Foundation included Dr. Milton Harris, Director of the Foundation's research at the National Bureau of Standards; Dr. R. Y. Winters, of the Department of Agriculture, and Alban Eavenson, of Eavenson and Levering, both members of the Advisory Committee for Scientific Research; and Dr. Frederick M. Feiker, consultant on textile education. Mr. Pickard also represented the Foundation in his dual capacity as executive secretary of both organizations. Franklin W. Hobbs, chairman, and Donald Comer, director, sent messages of regret at their inability to be present.

The National Bureau of Standards was represented by Dr. Lyman J. Briggs, Director, and Dr. Warren E. Emley, chief of the Division of Organic and Fibrous materials, and who is also a member of the Advisory Committee for Scientific Research.

Members of the research staff of the Foundation present at the conference included: Dr. Milton Harris, Director; Jacinto Steinhardt; Henry A. Rutherford; Arnold M. Sookne; Lyman E. Fourt; Francis W. Minor; Walter B. Geiger; Fritz Kobayashi; Charles H. Fugitt; Louis R. Mizell; Albert R. Martin; Charles Hock; Faith Morris; and Virginia Phelan.

• NEW YORK CLUB, P.T.S.

At an executive session held recently, the following men were designated for the various committees of the New York Club of the Philadelphia Textile School.

Committee on Aims & Purposes

Chairman—J. Elmer Hahn, Vice President, Lebanon Woolen Mills

Louis E. Kates, Secretary, French Fabrics Corp.

Lester E. Keiper, U. S. Testing Company

Financial Committee

Chairman—Harold C. Bell, Bell & Co.

Benjamin M. Prager, L. Bachmann & Company

Frederick M. Rapp, Pacific Mills

Membership Committee

Chairman—Thomas G. Pennington, A. M. Tenney Associates

Howard N. Smith, Hesslein & Co.

Frederick T. Mosedale, U. S. Testing Co.

Frederick W. Stolzenberg, Sidney Blumenthal & Co.

Committee on Arrangements

Chairman—Milton Schmidt

Committee for Nominations

Chairman—Max Schuster, L. Bamberger & Company

Edwin Wilkinson, National Ass'n. of Wool Mfgrs.

Richard M. Zelen, Capitol Pc. Dye Works

Committee on Public Relations

Chairman—Jack Jarmak, Cluett, Peabody & Co., Inc.

H. G. Battles, Turner, Halsey & Company

Stephen S. Marks, Fairchild Publications

Howard P. Galloway, President of the organization, announced a complete program for the '41-42 season, which according to plans will be quite varied.

The first meeting was held on October 9th at the Hotel Collingwood at 6:30.

• ADDRESSES D.C.A.T. MEETING

Before a capacity audience of two hundred executives at luncheon on Thursday, September 25, at the Hotel McAlpin, Beach Conger, Foreign Correspondent of the New York Herald-Tribune, vividly depicted the various methods employed by American correspondents in Germany and conquered nations to report the news to their American newspapers. The meeting was the first fall membership luncheon of the Drug, Chemical and Allied Trades Section of the New York Board of Trade with John J. Toohy, Chairman of the Section, presiding.

Mr. Conger stressed particularly the strict censorship in Germany and Greece but stated that most foreign censors were not familiar with American slang and therefore the correspondents in many instances managed to transmit true reports in spite of the censorship. The audience was particularly interested in the methods used by the Dutch in coping with German parachute troops during the invasion of Holland.

Prior to introducing Mr. Conger, the Chairman presented the following guests who were seated at the head table: Messrs. Arthur Snyder, President of the New York Board of Trade, Inc., and Treasurer of Alfred M. Best Company; Marshall W. Pask, Chairman of the Board's Securities, Commodities and Banking Section and one of the partners of Mackay and Company; Rudolph F. Berls, Vice-Chairman of the D.C.A.T. Section; James DeCesare, Chairman of the Section's Program Committee and President of White Laboratories, Inc.; P. Wesley Combs, Jr., Vice President of Wm. Esty & Company; and Wm. E. Robinson, Advertising Director of the New York Herald-Tribune.

• CHARLOTTE CHAPTER, PHI PSI

At the recent meeting of the Charlotte, N. C., Alumni Chapter of Phi Psi, national textile fraternity, C. W. Sampson, Southern Manager for Emery Industries, was elected president. B. Ellis Royal, associate editor of *Textile Bulletin*, was elected secretary.

Plans for an outing in October were discussed, as well as the possibility of the Charlotte chapter sponsoring the Annual Convention of the national organization, to be held in the spring.

• SIZING RESEARCH PROJECT

Subscribers to the spun rayon warp sizing research project which has been spon-

sored by the United States Institute for Textile Research in the North Carolina State College laboratories for the past year met Tuesday, September 16, at the Textile School.

Dean Thomas Nelson of the Textile School, chairman of the advisory committee on warp sizing, welcomed the visitors to State College. The meeting had been called by Dr. William D. Appel of the National Bureau of Standards in Washington. Progress reports were made by Professor William E. Shinn of the Textile School, research consultant in charge of the project; Paul T. Biggers, research associate; and Professor Arthur C. Hayes.

Attending the meeting were: Dr. William D. Appel, National Bureau of Standards; Don S. Bolley, National Lead Company; Dr. Frederic Bonnet, American Viscose Corporation; Irving S. Ellison and Fred P. Ingram, Keystone Glue Company; Dr. Paul Vasser Seydel, Seydel-Woolley & Company; Dr. Wm. E. C. Yelland, Corn Products Refining Company; F. D. Pilgrim, Tennessee Eastman Corporation; T. C. Davis, Stein Hall & Company; Erwin L. Laxton, Arnold, Hoffman & Company; Edward T. Pickard, executive secretary of the United States Institute for Textile Research; Dean Thomas Nelson, Professors A. H. Grimshaw, W. E. Shinn and A. C. Hayes, of the Textile School; and Paul T. Biggers.

• PLASTICIZER BY GLYCO

It is claimed that paper, textile and leather coatings made with clay dope dispersions can be rendered more flexible and have greater adhesion by means of a new plasticizer developed by the Glyco Products Co., Inc. This plasticizer, designated as S-376, can be stirred directly into the converters clay coating dope.

The procedure is to add the clay, carnauba wax emulsion, etc., to the pre-cut casein solution, stirring until completely dispersed. Then add, with high speed agitation, the S-376 in amounts of approximately 10 per cent, based on the total solids of the clay dope.

The final dispersion which remains stable, is said to improve the calendering operation and produce coated sheets with greater water resistance. Further details, samples and prices can be obtained from the Glyco Products Co., Inc., 230 King St., Brooklyn, N. Y.

• MURRAY MADE TEXTILE SALES MANAGER

Walter E. Murray has been appointed Textile Sales Manager of the Warwick Chemical Company. Mr. Murray will

Walter E. Murray

make his headquarters at the Warwick Chemical Company's main offices in West Warwick, R. I., but the nature of his duties will make it possible for him to continue with the friendships he has made in the field. His many years of experience in the textile industry includes executive duties with the U. S. Finishing Co., Lincoln Bleachery, Eddystone Finishing Co., and Pacific Mills.

• ONYX RELEASE

Onyx Oil & Chemical Co. has recently released a booklet describing the following product:—

Larv-O-Nil for Moth-proofing—The contents of this booklet include: a general discussion of moth damage, the life cycle of a clothes moth, moth-proofing of materials, requirements for ideal moth-proofing agents and a discussion of Imularv and Larv-O-Nil.

Three types of moth-proofing agents are available from Onyx, namely: Larv-O-Nil W, Imularv P and Larv-O-Nil S. Larv-O-Nil W is a water soluble protective agent said to be effective against all types of fiber eating insects. It is stated that it may be characterized as a general utility proofer requiring no special equipment for application, and on fabrics possesses effectice resistance to dry-cleaning and considerable resistance to wet washing. Imularv, like Larv-O-Nil W, is a water soluble proofing agent, which affixes itself on wool and all types of animal fibers in an acid dyebath and when once attached to the fabric is claimed to be fast to light, washing, rubbing, hot pressing, stoving, chlorine, perspiration, bleaching (50 per cent) carbonizing (50 per cent), spotting, sea water and dry cleaning. Larv-O-Nil S is an improved solvent type of moth-proofing agent especially designed for application to materials by spraying or from dry cleaning solvents.

Copies of the booklet are obtainable upon request.

• CLASSIFIED • ADVERTISEMENTS

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

WANTED: New England Commercial Dyehouse offers an opportunity to an experienced dyer with experience on Franklin Jackspool dyeing. The position will be permanent. Write Box No. 347, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED: Chemist with training and experience in field of organic and colloid chemistry for research work in vicinity of New York. Write Box No. 348, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED: Manufacturing Chemist, excellent opportunity, to take charge of production and laboratory. Broad experience in textile scouring, dyeing and finishing compounds—including gums, starches, resins, pigments, soaps, etc. Jersey City vicinity. Write Box No. 349, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: American born. Age 41. Married. Ten years' experience in one of largest textile mills in U. S. as colorist, chemist, and assistant dyer on raw stock using vat, sulfur, and direct colors. Four years in laboratory as standardization colorist for large dyestuff manufacturer. At present, boss dyer in small textile mill dyeing all varieties of rayon and acetate, and mixtures of rayon and acetate piece goods. Desires position as colorist and demonstrator. Excellent references. Write Box No. 350, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.